Live Steam

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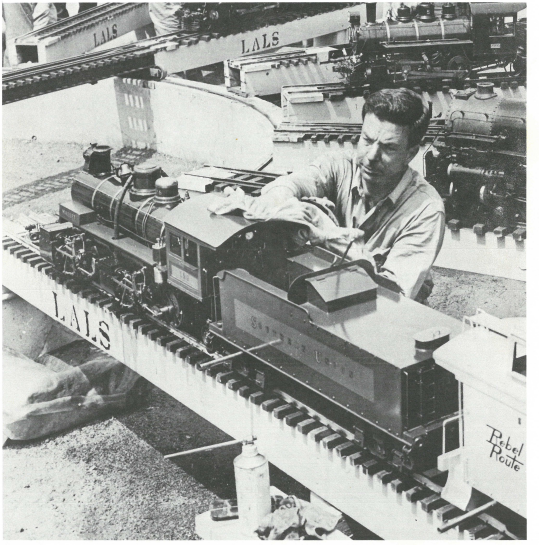


GENE MACKLEY

Part 1

Technical Notes on Tractive Effort

by W. MARSHALL BLACK

Los Angeles Live Steamers

The majority of the very limited North American literature on the Live Steam model locomotive hobby deals with construction from an amateur machinist's viewpoint. Little is to be found that informs the modeler of the fundamental relationships that governed steam locomotive performance and dictated the terms of its long evolution. One all but loses sight of the fact that, in addition to being more or less finely wrought pieces of machinery, the steam locomotive was always a collection of theoretical compromises carefully contrived, in light of intended track conditions, to achieve for prolonged periods one or another end: speed, power, or work. Thus the infinite variety.

After the thousands of hours required to build a model engine, few builders can view their engine's operation objectively or even desire to analyze its performance deficiencies, if any. If it won't pull, they run light: if it won't work steam hard for prolonged periods, they run into the steaming bay to rest. One may often see scores of finely crafted models at a meet; but how often does one see a grimy little engine just completing an hour's continuous run with scale equivalent of a 1,000-ton train in tow? A truly beautiful moment this would be and the builder would have given us a glimpse again of what it once was all about. Further, his engine would be worthy of very thorough analysts to develop meaningful criteria: i.e., desirable "locomotive ratios" for scaled-down practice.

While we are waiting, though, this is the first of a three-part series of technical notes on some of the more fundamental facets of locomotive design, and a report of an interesting test run. While the writer works in one-inch scale, the general relationships, unless qualified, apply to any scale.

Some measurements of dead pull required to start Southern Union 1'' scale cars equipped with Lewis (Little Engines), Nelson Gray and homemade 4-wheel trucks with brass journals led to the following relationship:

Equation 1

$$t = 0.035\ (w) - 0.5$$

where t = starting effort on straight level track, pounds
w = total weight of car and load, pounds
(See Figure 1)

Measurements on several locomotives (a 2–4–2, a 2–4–4–2, and a 4–6–2) showed a force equal to roughly 6% of engine weight is required to ''break'' an engine loose.

These experiments would allow prediction of starting resistance of a rigidly coupled 1'' scale train as follows:

a)	Locomotive: 222 pounds x .06	13.3 pounds
b)	Tender: 0.035 (277) – 0.5	9.2–
c)	Car 1: 0.035 (400) – 0.5	13.5+
d)	Car 2: 0.035 (230) – 0.5	7.5+
	Total train starting resistance	43.5 pounds

In this example, the tender and all cars are assumed to weigh 60 pounds light. The tender carries 37 pounds of water and 10 pounds of coal plus an engineer at 170 pounds. Car 1 is loaded with two riders at 170 pounds each; car 2 has one rider. A total of 43+ pounds starting effort is required for this small train. This value should not be confused with the lesser effort required once the train is rolling or with variation caused by grades, curves, or acceleration. Neither should it be confused with drawbar pull which is often construed as pull available behind the tender. We'll treat these in Part III of this series.

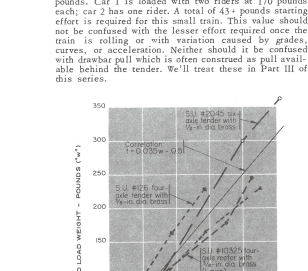

CAR AND LOAD WEIGHT – POUNDS ("w")
POUNDS DEAD PULL TO START ROLLING ("t")
Correction
t = 0.030w – 0.5
S.U. #2045 six-axle tender with ¼-in. dia. brass
S.U. #125 four-axle tender with ¼-in. dia. brass
S.U. #1325 four-axle motor with ¼-in. dia. brass (Lewis)
S.U. #15 four-axle caboose with ¼-in. dia. bronze (Gray)

FIGURE 1

CORRELATION OF CAR WEIGHT vs. STARTING PULL

COVER PHOTO – W. Marshall Black wiping down his Southern Union 2–4–4–2 compound mallet at the steaming tracks of the Los Angeles Live Steamers. Marsh built this 1'' scale locomotive from scratch and used it, along with his 1'' 4–6–2 in developing the text of this series on tractive effort.

Now let's couple the engine, crack open the throttle and see what happens. Chances are she'll slip like mad if it's late on a heavy traffic run day at the local track when the track is wet and oily. On the other hand, with a little sand or a dry track, she'll probably stomp right out of the station. Let's look into why.

Further experiments with several locomotives demonstrated adhesion factors ranging from 0.10 on oiled steel rail up to 0.35 on dry sanded aluminum rail. Adhesion factor is defined as follows:

Equation 2

$$a = \frac{t}{bW}$$

where: a = adhesion factor, fraction (or percent/100)
t = pull at Slip point, pounds
b = fraction of engine weight on drivers (or percent/100)
W = gross engine weight, pounds

An adhesion factor of about 0.2 is believed reasonable for average conditions on a club track. It can deteriorate to zero on wet oily rail or improve to about 0.3+ under very best conditions. This, incidentally, agrees well with prototype practice. Rearranging Equation 2 we have:

Equation 3

$$t = abW, \text{ or: } W = \frac{t}{ab}$$

This is a fundamental relationship. It says an engine can exert no more dead pull than about one-third its weight on drivers under best track conditions, and more often, less.

Now to return to our train. Let's assume the track is at average condition (a = 0.2). Right away we know that to start the train requiring 43 pounds dead pull, we had better send out an engine weighing at least:

$$\frac{43}{(.2)\ (.9)} = 240 \text{ pounds gross, assuming 90\% of gross weight is on drivers.}$$

But is this enough for an engine dispatcher to know? Not by a long shot! An engine with a too small cylinder area, or too short a stroke, or too large drivers would just sit there and groan even it it weighed 300 pounds. In other words, the starting pull is limited by Equation 3; however, the running gear must be properly sized to develop this limiting value. Now, how do we rationalize running gear dimensions? The following equation gives theoretical tractive effort in terms of engine dimensions:

Equation 4

$$t = \frac{1.26\ c\ P\ A\ S}{D} \quad \text{or}$$

$$t = \frac{c P d^2 S}{D}$$

where P = boiler pressure, psi
A = average cylinder area, head and crank end, square inches
S = stroke, inches
D = driver diameter, inches
c = fraction of P in steam chest at starting condition (c = 0.9+)
d = cylinder diameter, inches

Equation 4 says that tractive effort increases as boiler pressure, cylinder area, and stroke increase, and decreases as driver diameter increases. Thus, drag engine had small drivers and big cylinders, while old No. 999 was the other way around so it could fly. Both would reach maximum design speed at about 300 rpm; however, this is getting into horsepower criteria which is beyond the scope of this particular note.

When Equation 3 is set equal to Equation 4, a very informative relationship between engine weight, running gear dimensions, and boiler pressure results:

Equation 5

$$abW = \frac{1.26\ c\ P\ A\ S}{D} \quad \text{or}$$

$$abW = \frac{c P d^2 S}{D}$$

Equation 5 is fundamental for design purposes, and is very useful for tune up of a finished engine. Plug in the dimensions of your existing engine, using a value of 0.2 for (a) and 0.9 for (c). If the value of the right hand side of the equation is larger than the left, chances are you've got a slippery (overpowered) engine on average track and you might consider adding weight. If the reverse is true, you've got a staller and could stand to raise the boiler pressure. Or, if you haven't started building yet, plug in value for the dimensions you want to fix, driver size and cylinder diameter, for example, and see how the other dimensions (or boiler pressure) shape up. Use (a = 0.3) for design. The table below gives solutions in terms of cylinder diameters for several weights of engine and driver diameters with P = 100 psi; c = 0.9; S = $2^{1}/_{2}$; a = 0.2 and 0.3. 90% of engine weight is assumed to be on drivers (b = 0.9).

There are, of course, myriad reasons for departing from Equation 5 for design. For one thing, train draft gear usually has some give or slack, so the engine gradually picks up the load; it rarely must start a rigid train. This is an argument for smaller cylinder diameters. On the other hand, it's good to have larger diameters if stopped on or near a crank center, or if caught with low boiler pressure. Models almost invariably are overpowered for their weight; i.e. they are slippers rather than stallers. Model builders get by with this because they seldom really "work steam" at high speed for a prolonged period and, therefore, the boiler can always keep up. The important thing to note is that the maximum possible weight should be on the drivers; however; once you've arranged this you are at the mercy of adhesion factor. Part II of this note will discuss the factor b – fraction of weight on drivers.

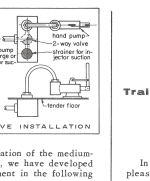
Gross Engine Wt. lbs b = .9	CYLINDER DIAMETER – INCHES* D = 4 in. a = .2	a = .3	D = 5 in. a = .2	a = .3	D = 6 in. a = .2	a = .3	D = 7 in. a = .2	a = .3	D = 8 in. a = .2	a = .3	Limiting Draw Bar Pull-lbs a = .2	a = .3
100	.67	.81	.74	.91	.81	1.00	.88	1.08	.95	1.16	18	27
150	.81	1.00	.91	1.12	1.00	1.23	1.08	1.33	1.16	1.42	27	40
200	.94	1.15	1.05	1.29	1.15	1.41	1.25	1.52	1.34	1.64	36	54
300	1.15	1.41	1.29	1.58	1.41	1.73	1.53	1.87	1.63	2.00	54	81

* to adjust to S = 2.5 inches, multiply values by 0.9

An interesting

INJECTOR EXPERIMENT

by William Van Brocklin, Jr.



VALVE INSTALLATION

Faced with the desire to provide foolproof operation of the medium-size commercial injector on our 3½" gauge 4–4–0, we have developed an arrangement that seems to satisfy the requirement in the following manner:

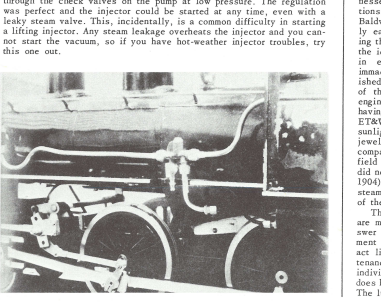
In essence, a large-hole (1/8" diameter) plug valve was fitted to the overflow side of the injector and the suction line was connected to the hand pump discharge via a 2-way vlave in the tender. By closing the overflow valve and turning the 2-way valve to receive the hand pump discharge, the boiler can be filled when cold or (when in steam) a slug of water can be pumped through the injector to cool down the boiler and fill the lines.

For normal injector operation by steam, the 2-way valve is turned to take suction water from the tender and also regulate as necessary due to varying steam pressures. Of course in this operation the overflow valve on the injector is opened.

Of course, this hook-up isn't as effective on small injectors since you can't pump through a tiny delivery cone, but with the medium size units (with about a #68 drill delivery cone) it works well without putting too much load on the hand pump. The hand pump used in this experiment has a ½" bore and 1-1/8" stroke.

In combination with this hook-up, an "O" ring seated ball check valve was made that is absolutely leak tight . . . or as they say in the trade, "Bubble tight." It cannot wear out as the seat is neoprene. The ball valve simply sets on the "O" ring periphery and pressure makes it tight. Support for the the "O" ring is necessary, of course, to prevent it from blowing out.

In practice this arrangement worked fine and even with the 2-way valve turned to hand pump discharge, the injector would pull water through the check valves on the pump at low pressure. The regulation was perfect and the injector could be started at any time, even with a leaky steam valve. This, incidentally, is a common difficulty in starting a lifting injector. Any steam leakage overheats the injector and you cannot start the vacuum, so if you have hot-weather injector troubles, try this one out.



Train-watching along the

In the past few years, a most pleasant part of train-watching has passed into "limbo"—the viewing of a steam locomotive in action! There are, fortunately, many "amusement" railroads in operation, and even with phoney diamond stacks and fake oil-burning headlights, the locomotives are still a most fascinating bit of mechanical complexity—the sights and sounds are as of old! To the ever faithful, the truth is hard and real—the "chemin de fer" will never return to the High Iron. The clock never goes backward, and some of the color has left forever.

There are, however, as in all things, exceptions to every rule and some steam locomotives are in operation as wage earners. Fortunately, their future is assured for a few years anyway, for at the present time the purchase of diesels is not sound economy.

The East Tennessee and Western North Carolina Transportation Company located at Johnson City, Tennessee has two 2–8–0 Consolidations, one built by Alco and one by Baldwin. They are operated alternately each month—each engine receiving the necessary maintenance during the idle period. Both engines appear in excellent operating condition—immaculately clean even to the polished rods and all the moving parts of the Southern valve gear. These engines are ex-Southern Railway, having been in the service of the ET&WNC for about 12 years. In the sunlight, they glisten like polished jewels—in direct contrast to the comparatively new and grimy Clinchfield Railroad diesel switcher. If one did not know the builder's date (Alco 1904) it would seem as though the steamer by appearance is the newer of the two.

The personnel of the ET&WNC are most cooperative—willing to answer all questions and the management is not hostile to railfans who act like gentlemen. The daily maintenance is performed by an energetic individual who, without direction, does his daily tasks with enthusiasm. The lubrication was done with gusto,

East Tennessee & Western North Carolina

by ROBERT W. MAYNARD
Secretary of the
Cincinnati "Cinder Sniffers"

including the addition of grease to the wheel flanges to prevent squealing on tight curves. The locomotive is wiped down and the cab swept as a part of the preparing ritual and apparently the operating crews share this "esprit de corps" because the smoothness of movement is noticeable.

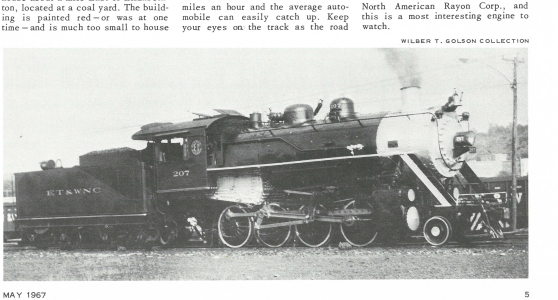
The track is 112 lb. rail, well ballasted, with all the spikes securely fastened, and winds nine miles around the low foothills between Johnson City and Elizabethton, Tennessee. Originally, a third rail for 3' gauge was used, but the narrow gauge operation was discontinued in late 1946. The section of narrow gauge line East of Elizabethton was 3', and was known as the "Tweetsie Line." Some evidence of the right-of-way is still visible including a bridge or two and a tunnel. This section of railroad would have been most interesting to ride—it is a shame to have been 20 years too late! Other than the right-of-way, the only evidence of the narrow gauge is an old engine house about a mile East of Elizabethton, located at a coal yard. The building is painted red—or was at one time—and is much too small to house anything but narrow gauge engines.

From Cincinnati, take I-75 to 25E, then 11E to Johnson City. The railroad is located on the East side of town and is about two blocks to the right off Highway 91. The turn is at the traffic light located near the Fair Grounds. You may drive right up to the engine shed, and if one keeps out of the way of the working people, the railroad management doesn't seem to mind.

Highway 91 parallels the track and on the Eastern end of the line, gives the best places for photography, but on the Western side (Johnson City), the road that follows the track is unmarked. To find it, go South following the track leaving Johnson City. The road leads through a somewhat run-down section of dwellings. Be careful here—children are playing in the roadway, so trying to pace the train is difficult. The road makes a grade crossing, and a rather bumpy short section will slow you before you reach the paved path. Don't worry about not catching the engine as the train will slow to about 10 miles an hour and the average automobile can easily catch up. Keep your eyes on the track as the road will make an abrupt left hand turn, and as these small country paths are unmarked, to follow by eye is the best way. There is a good spot for photography in a church yard, and the track passes within a few feet on a gentle curve. Further on is a cut, close and easy to see. From here to Elizabethton, you're on your own. My advice is to make the run before the train leaves.

The engineman gets up steam about 9:00 a.m. The engine is moved from the shed about 11:00 a.m. and from 11:30 until 1:00 or 2:00 p.m., the train is made up in Johnson City. The engine pulls the cars to Elizabethton, running backwards. The return trip is made on the head end, but does not take place until 5:30 or 6:30 p.m. which is darkness in the winter. There is a great deal of switching done at the North American Rayon Corp. and Bemberg Chemical at Elizabethton. You can get good shots of this. On the return trip, the stop for water at the Bemberg Station water tower. Some switching is done with a "Fireless Cooker" at the North American Rayon Corp., and this is a most interesting engine to watch.

WILBER T. GOLSON COLLECTION



Live Steam Operation Planned in Winnipeg!

H. R. CLARKE

"Old #3" of the City Of Winnipeg Hydro will be operating over a 14-mile route through suburban Winnipeg this year according to plans announced by John LaPage, 5-16 Roslyn Road, Winnipeg 13, Manitoba. The Metropolitan Corporation of Greater Winnipeg will conduct the tours with the 1882 4-4-0 and coaches of the 1880–1890 era from May 24th through October 1967 over tracks of the Canadian Pacific, Canadian National and the Midland Railways. For further information contact Live Steamer John LaPage at the above address and plan to stop out at the Red River Valley Railway tracks (2½" – 3½" – 5" gauge) when you visit Winnipeg. The welcome mat will be out to all Live Steamers.

NEXT MONTH . . .

Walt Disney's love of Live Steam found expression in his private life as well as his public activities. Ollie Johnston gives us a look at Walt's offstage interest in this hobby that we all enjoy.

WHEELS, TREADS AND GAUGE will be discussed and explained in Part III of Joe Nelson's 6th Chapter in the series "So You Want To Build A Live Steam Locomotive."

Marsh Black's "Technical Notes on Tractive Effort" will consider the importance of weight on drivers, and how to obtain the optimum without converting your 4–6–2 to an 0–6–0!

. . . plus all the latest about bells and Bell Ringers in LIVE STEAM!

1871 VINTAGE DRAWINGS IN NEW BOOK

If you are a Live Steamer looking for authentic details of an old locomotive or if you are interested in knowing how older locomotives were constructed . . . or if you just enjoy studying drawings as only men in the 1870's could prepare them, *American Locomotive Engineering* will appeal to you!

Originally published in 1871 by G. Weissenborn's Engineering Office in New York City it has just been republished by Glenwood Publishers (who, in reality, are Live Steamers Thomas E. Williams and Charles H. Givens of the Golden Gate Live Steamers.)

The outstanding collection of 96 fine engravings of nine Mid-19th Century locomotives includes 0–6–0, 2–4–2, 2–6–0, 2–8–0, 4–2–4 and 4–4–0 types, and in addition to the beautiful shaded elevation drawings, detailed dimensional drawings show virtually every part of the engines.

American Locomotive Engineering is offered in two editions; a soft-covered plastic-bound edition which sells for $6.00 and the DeLuxe Edition which is bound in hard, cloth covers for $9.50 each. Both editions are 9 x 12 inches in size and the drawings are, for the most part, reproduced at a scale of ¼" = 1' 0".

Only 1,000 individually numbered copies of the DeLuxe Edition have been prepared and either edition may be ordered direct from LIVE STEAM, Post Office Box 328, Birmingham, Michigan 48012.

RUNNING GEAR

SO YOU WANT TO BUILD A LIVE STEAM LOCOMOTIVE

CHAPTER 6

by Joseph F. Nelson

LEAD TRUCKS

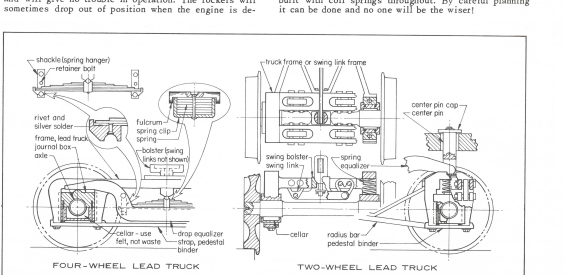
The lead truck is something more than just a supporting device for the front of a steam locomotive. The word "lead" as a transitive verb is defined as: To guide or conduct. This lead function is assisted in a major way by swing links or rockers interposed between the bolster and the truck frame. Early locomotives used simple two-pin swing links on their lead trucks similar to the model T and A Ford spring shackle. While this design was satisfactory for moderate speeds, it left much to be desired for high speed steam locomotive lead trucks; however, it is very satisfactory on diesel locomotives and passenger cars.

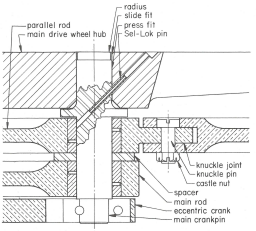
The three-pin or heart-shaped swing link is a self-centering device that will hold a locomotive in a straight direction on a tangent track and will tend to pull the front end of a locomotive in the direction of the curve. This is due to the quick acting lift of the three-pin link which transfers some of the weight from the drivers to the lead truck at the same time applying force to swing the bolster into the curve. As the tangent track is reached, the swing links drop back to center and align the locomotive with the straight track. Practically all of the later locomotives were equipped with the self-centering rocker on both the lead truck and trailing truck. It is the writer's opinion that for the Live Steam locomotive lead truck, the three-pin swing link is easier to build and will give no trouble in operation. The rockers will sometimes drop out of position when the engine is derailed or is being loaded or unloaded. This is no problem on the trailing truck since the rockers are accessible; however, relocating a rocker on a lead truck is more of a problem.

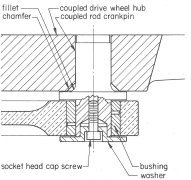
The four-wheel lead truck is normally not tied in with the equalizing system; however, some notable exceptions to this practice were Pennsy's E-6 and first K-4, the U.P. 4-12-2, and Big Boy. It is assumed that an equalized lead truck will have less effect on traction than a non-equalized lead truck since there will be less weight transfer from the drivers to the lead truck on curves or rough track; however, on passenger engines, high speed performance is the objective and a slight loss of traction at high speed is not a problem.

Where a person is building his own lead truck frame, it might be a wise move to consider the purchase of some of the small parts; flat springs, coil springs, swing links, self-centering rockers, etc., since they can be purchased rough or machined at Little Engines and other suppliers of Live Steam equipment. It should be noted at this time that supplies for the two-wheel lead truck are hard to come by; however, the 1½" scale Mogul is on the market and parts and trucks are now available.

Where one doesn't care to use flat springs on the four-wheel lead truck, one may dummy the flat springs and use them as secondary equalizers. Coil springs may then be used, hiding them behind and supporting them by the drop equalizers. The author's D-16A was built with coil springs throughout. By careful planning it can be done and no one will be the wiser!



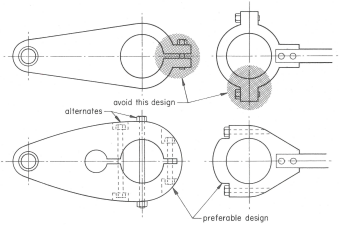




MAIN CRANKPIN

COUPLED ROD CRANKPIN

C R A N K P I N S



CRANKPIN BUSHING

ECCENTRIC CRANKS

ECCENTRIC STRAPS

E C C E N T R I C S

JRH/wct

For a non-equalized two-wheel truck, the builder should use spring-supported journal boxes. Where an equalizer ties the two-wheel lead truck to the rest of the equalizer system, the builder may, at his discretion, delete the springs and mount the journal boxes rigidly in the truck frame and depend on the flexibility of the springs in the rest of the equalizing system.

The center pin must be free in relation to the two-wheel truck frame so as to permit the truck to flex freely, yet be restrained so that it will lead the engine around curves and hold it in a straight line on straight track. Since the two-wheel lead truck is like the Ford models A and T front suspension, radius bars must be provided to hold the truck frame in alignment with the center pin, yet permit it to move up and down, to swivel, and to move from side-to-side as permitted by the swing links. Since the Live Steam locomotive is frequently derailed and also lifted from the track, every precaution should be taken to see that everything is secured so that it will not drop off when the engine is raised from the rails. Such builders are rather prone to omit not securing center pins on car trucks and lead trucks. All it takes is a cotter pin and more than one engine has had its lead truck drop in the ensuing pit because some well-intentioned but incompetent character wanted to be helpful!

CRANKPINS

For press (interference) fits, it is customary to allow 0.001'' per-inch of diameter over 1'' and about 0.0005'' to 0.0075'' for most press fits under 1''. This, depends, of course, upon the roughness of the bore, the type of metal, and the thickness of the metal surrounding the bore. A drive wheel hub, for example, has lots of metal surrounding the axle and crankpin holes, and even though the hub is relatively brittle cast iron, it can stand a shrink press of 0.0015'' to a maximum of 0.002'' per inch of diameter. Since the eccentric crank exerts a twisting force on the main crankpin, this crankpin frequently starts to revolve in the wheel hub, thereby throwing that side of the engine out of time. It would be advisable, therefore, to secure the main crankpins against turning. A diagonal hole should be drilled from the eccentric nut through the hub of the wheel, making certain to clear the driving box by drilling in the direction away from the axle and not toward it. Remove the burr on the crankpin with a fine file. Drive in a Set-Lok, Groove Pin, or equal. A taper pin is not recommended for the novice since fitting a taper pin requires a certain amount of shop training. Also, most drills are not large. To drill a hole to size, drill with a slightly smaller drill, then ream with the correct size drill.

When making a crankpin castle for press fit, turn a short length of the starting end about 0.001'' smaller than the bore and round off the end. This will permit the shaft to enter straight. Countersink the starting side of the hub to clear the flange fillet so that the outer edge of the flange will set square against the hub. A fillet riding a sharp edge will most certainly cause the shaft to snap off at that point. A mixture of white lead and steam cylinder oil has been the standard lubricant for a press fit. Moly Disulphide and steam cylinder oil is also good.

Crankpin bushings should float in the rod, allowing approximately 0.002'' clearance on the crankpin and fitting the outside diameter so that they can be pressed into the rod bore with the thumb. The bushings will start turning and will revolve enough so that they will wear evenly and not egg-shape. Make certain that the oil groove on the outer diameter is staggered and not straight around, otherwise a groove will wear in the rod. A simple shallow cross oil groove about 1/64'' deep will distribute the oil to the staggered oil groove and oil holes. Cast iron or Super Oilite make the best bushings. DO NOT USE free machining brass!

For the benefit of the non-machinist, a drill will not go straight across an open space – it crawls some before it centers itself for the second hole. The result is that the two holes do not line up. When drilling and reaming the parallel rod knuckle joint, drill through solid metal before slotting or clamp the two rods together and then drill. This applies to all drilling of this type.

ECCENTRIC CRANKS AND ECCENTRICS

Since this section deals with machine design, the setting of the eccentric and eccentric crank will be discussed from a theory standpoint in their respective valve gear sections.

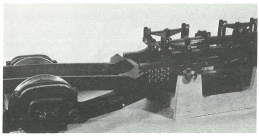
For eccentric crank design, the builder should consult drawings of his prototype and one thing will stand out – the eccentric crank is both clamped and keyed against rotation. Also, it will be noticed that the clamping bolts are as close to the shaft as possible and are not trying to clamp easily-bent long ears. When machining the eccentric cranks, a layout of all the holes should be made and the bolt holes drilled before boring the main crankpin hole. By doing it this way, the keying hole will be straight through the crank and will provide a guide for later drilling. Drilling the side of the crankpin for the keying bolt may be done after the eccentric crank is ''set'' and then clamped by the clamping bolt.

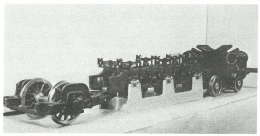
The main crankpin center to eccentric crankpin center is very critical and should not be a scaled down version of the prototype. This also goes for the angular setting of the eccentric crank. These dimensions are only good for your particular engine as determined by your layout, or the drawing of where laid out that valve gear. Make certain that the eccentric crank stroke is the same as the layout calls out. Any attempt to increase or decrease the valve travel without relaying out the eccentric crank will make only a very lame engine. Swinging the eccentric crank in or out does not turn the trick.

Eccentrics should be bored to a snug running fit on the axle and the hub should be drilled and tapped for two socket head flat point set screws. DRILL AND TAP AT 90°. DO NOT DRILL AND TAP AT 180° (opposite). This applies to any set screws wherever they are. When machining eccentrics: 1) Turn outside diameter, then machine mating face and flange face. 2) Make boring fixture to be chucked in lathe for boring the eccentric axle holes. Offset the fixture in the chuck equal to the eccentric throw. NOTE: The eccentric throw is one-half the stroke. Mark high point of throw on fixture and each eccentric with prick punch. 3) Clamp eccentrics in the fixture, then drill, bore, and face. 4) Do not remove fixture from the chuck until all eccentrics have been bored. NOTE: Required uniformity of eccentric throw demands that all the eccentrics be bored at one setting of the boring fixture. Where the hole is reamed after boring, allow 0.005'' for reaming.

EQUALIZING

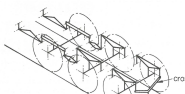
When laying out the equalizing system, the locomotive builder should study his prototype, paying particular attention to levers with unequal arms. These must be duplicated. By taking advantage of the three-hole equalizer fulcrum, an adjustment is provided to vary ''weight on drivers.'' Adjustment of the equalizing system can best be done before the wheels are pressed on the axles. The axles should be set on parallels at their normal height above the rails. It will also be necessary to add weight to the cradle above the trailer truck to balance the weight of the cylinders so that the frame will set level and parallel with the axles. Set all equalizer pins with the head in and cotter pins out to permit removal.





DOUGLAS ALKIRE PHOTOS

The method of setting spring rigging and equalization is illustrated in these photos of a 1" scale B & O "President" being built by Douglas Alkire of 220 East Hellman in Monterey Park, California 91754. A cradle supports the driving axles at operating position so that the drivers may be left off, simplifying adjustment.



SIX-WHEEL SWITCHER

FOUR-WHEEL SWITCHER

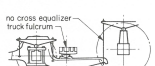
TYPICAL SINGLE AXLE LEAD TRUCK SYSTEM

Note equalizers on rear driving boxes to clear firebox. The two equalizing systems, in many cases, are separated between the second and third driving axles, particularly on systems with five driving axles.

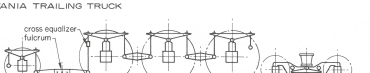
NOTE: Live Steam modelers may use dummy leaf springs, then hide coil springs inside hanger brackets.

TYPICAL 4-4-0 AND 4-6-0 SYSTEM

Standard practice on early Americans is to locate springs and equalizers above the frame.



PENNSYLVANIA TRAILING TRUCK



TYPICAL SPRING RIGGING FOR PASSENGER ENGINES

In those rare cases where a four-wheel leading truck is equalized, two separate equalizing systems are used. (See the Single Axle Lead Truck System above.)

EQUALIZING SYSTEMS

JPN/wcf

AN IMPORTANT CORRECTION AND AN APOLOGY . . .

is in order with the April issue of LIVE STEAM. The fine article on A VACUUM BRAKING SYSTEM was credited to Carl Purinton who sent the material to us. Carl's accompanying letter mentioned that the credit should go to his son, Charles S. "Charlie" Purinton for the material, but during the several months since we received it the letter got into one file and the article in another. When it finally got to the top of the pile for publishing, we just plumb forgot!

Our humble apologies to Charlie Purinton. It must be downright revoltin' to do all that work and then have someone else get credit for it! We promise that we won't make that mistake again.

GOLDEN GATE LIVE STEAMERS PLAN 1967 MEETS

The Golden Gate Live Steamers' track at Redwood Park, 7867 Redwood Road, Oakland, California will be the scene of two open meets in the next few months. The Spring Meet will be held on June 3rd and 4th and the Fall Meet is scheduled for September 9th and 10th, 1967.

A picnic supper will be a feature of the Saturday evenings of these two meets, and these are usually followed by some enjoyable trains running if the weatherman cooperates. A guard is provided so that equipment may be left at the track overnight for the next day's running.

Joseph W. Bryan is Secretary for the GGLS and can be reached at 1225 Scott Street, El Cerrito, California 94530 for further information.

OMAHA AREA LIVE STEAMERS BEGIN TRACKWORK

Four active Live Steamers in the Omaha (Nebraska) area have banded together to form the Omaha Area Live Steamers. Donald Parrish was elected the first President of the organization and Robert Recic (5022 So. 93rd Circle, Omaha, Nebr. 68127) as the Secretary-Treasurer.

With adoption of a Constitution and Bylaws out of the way, they quickly went to work on a three-rail ground-level loop of ¾" and 1" track which will be followed by a 1½" loop in the near future.

An ideal location with a potential of a half-mile track circling a small lake is available and there will be ample opportunity for trestle work on the site.

Membership is open to interested Live Steamers in the surrounding area by contacting Bob Recic at the above address.

Finished Track

by S. H. GALLOWAY
Secretary, Montreal Live Steamers
Editor—MLS "ROUNDHOUSE"

Now I'm sure that every club and owner of a train track has realized construction of an aligning stick and a track maintenance wagon and is anxiously awaiting this third and last article on how to have the perfect track. And I'm also sure that while you have been waiting, you have been busy trying out the two devices and working on your track.

You fellows are going to say me for this, but if my surmises are correct you have already found out about that last item. That's right, it's a big bucket of elbow grease, obtainable from any willing club member or owner. Go to it, boys! Happy Steaming!

SAFETY FIRST
is not a slogan. It is
RULE ONE
in Live Steam

ACCIDENT REPORT CARRIES SAFETY SUGGESTION

On March 28th Bert B. Brooks of 3028 Beechwood Lane in Falls Church, Virginia 22042 was involved in a serious accident on his 1½" scale railroad. He asks that this report be made as an advisory warning to other Live Steamers:

"I was coasting on a flat car which was equipped with ball bearing trucks when I inadvertently leaned backward, causing the leading truck to lift off the track. Realizing this I leaned forward, but instead of re-railing, the truck lowered against a tie and stopped dead still!

"Since my hands were on the sides of the car's one center seat my head and face struck the ties and ballast with all of my 180 pounds behind it which resulted in severe lacerations and a nerve injury yet to be determined, in addition to partial paralysis of my left arm.

"A good lesson was learned: NEVER RIDE A CAR UNLESS PROPERLY SEATED AND EVERYTHING IS UNDER CONTROL!"

Bert operates a LITTLE ENGINES 4–4–0 on a 400' loop of 7½" gauge track with 30' curves and would be interested in hearing from other Live Steamers in the area regarding the possibility of a visit to run their locomotives on his track. His injuries will delay completion of a water tank and additional cars, "... but" he says, "they will be completed!"

GREAT LAKES LIVE STEAMERS MEET IN GREENFIELD VILLAGE

For several years members of the Great Lakes Live Steamers in Dearborn, Michigan, have been displaying their models during the annual meetings of the Old Engine Club at Henry Ford's Greenfield Village but without the opportunity for operation.

This year, however, the group is moving its 3½" track to the Village and will have facilities for operation of ¾" scale locomotives during the Old Engine Club activities on May 11, 12, 13 and 14.

Live Steamers who will be in the Detroit area on those days are invited to bring their ¾" scale locomotives and operate them on the GLLS track. It will be well to make prior arrangements with George White, 29981 Leona, Garden City, Mich. 48135, phone 313-422-4311 or Eric Corbett, 4128 West Point, Dearborn Heights, Mich. 48125, phone 313-561-3506.

ORGANIZATION IMMINENT FOR LIVE STEAMERS IN MICHIGAN

Twenty-seven Live Steamers have indicated interest in a state-wide club. Of these 27, 6 are active in ¾" scale, 5 in 1" scale and 16 in 1½" scale with three 1¼", two 1" and ten 1½" scale locomotives operating. In each gauge there is some track available and plans are additional locomotives under construction.

An initial meeting will be called in the very near future for the purpose of organization, selection of a club name and for the election of officers. There is still time for interested parties to make their presence known and this can be done by contacting J. Bulkley G-7078 Clio Road, Mt. Morris, Michigan 48458.

NORTHERN ILLINOIS LIVE STEAMERS

Twenty Live Steamers from the Chicago area formally organized themselves as the NORTHERN ILLINOIS LIVE STEAMERS at their first formal meeting on March 5th, 1967. Their purpose will be to construct and operate track and facilities for Live Steamers.

Membership will be offered in several categories including Regular, Associate, Affiliate, Junior and Honorary or Emeritus depending on activity, proximity and age.

Investigation of possible track sites are being conducted by a committee and other groups will study track planning, financing and promotion as decisions are made.

George "Doc" Youngdahl, O.D., 1600 South 15th Avenue, Maywood, Illinois 60153 is Secretary and may be contacted for further information.

WOODLAND CENTRAL R.R. CO.

1" SCALE - LIVE STEAM

FRANK J. BAUER DONALD F. BAUER

GEN. OFFICES: 91 HICKORY LANE DEERFIELD, ILLINOIS 60015

Dear Bill:

I hope there is some space available in LIVE STEAM to tell all Live Steamers that we still have some of the BROTHERHOOD OF LIVE STEAMERS decals available. If they haven't ordered theirs, they can send 50¢ to the above address and we will send it out right away.

With all the Scheduled Meets coming up, it would be good to see one of these decals in the rear window of every car belonging to a Live Steamer.

I would like, too, to somehow thank the many people who have written to me for their kind words. Their comments make the effort very gratifying.

Thank you. Summer's coming - good steaming!

Don

Scheduled Meets

MAY

6 OMAHA AREA LIVE STEAMERS
Under construction
Robert Recic, Secretary
5022 South 93rd Circle
Omaha, Nebr. 68127

6 to 14 CHICAGO MODEL ENGINEER'S ASSN.
Annual Show – Museum of Science and Industry.
Perry Smith, Secretary
3430 West 65th Street
Chicago, Ill., 60629

11 to 14 GREAT LAKES LIVE STEAMERS
Old Engine Club Meet
Greenfield Village, Dearborn
George White
29981 Leona
Garden City, Mich. 48135

19 20 21 PIONEER VALLEY LIVE STEAMERS
Annual Spring Meet
3½" – 4¾" – 7¼"
Robert W. Sattler, President
374 Prospect Avenue
West Springfield, Mass. 01089

24 CITY OF WINNIPEG HYDRO #3
Begins 14-mile excursion trips
RED RIVER VALLEY RAILWAY
2½" – 3½" – 5"
John LePage
5–16 Roslyn Road
Winnipeg 13, Manitoba, Canada

27 28 29 30 LOS ANGELES LIVE STEAMERS
Annual Spring Meet
3½" – 4¾" – 7½"
W. Ross Crawford, Secretary
6900 Royer Street
Canoga Park, California 91304

27 28 29 30 PENNSYLVANIA LIVE STEAMERS
Annual Spring Meet
2½" – 3½" – 4¾"
Frank H. Moore, Jr., Secretary
211 Walnut Avenue
Wayne, Pennsylvania 19087

JUNE

3 4 GOLDEN GATE LIVE STEAMERS
Annual Spring Meet
2½" – 3½" – 4¾" – 7½"
Joseph W. Bryan, Secretary
1225 Scott Street
El Cerrito, California 94530

10 11 ONTARIO SUNPARLOR LINES
Annual Spring Meet
2½" – 3½" – 4¾"
Jack Hart, Secretary
1381 Shepherd Street
Windsor, Ontario, Canada

16 17 18 NEW JERSEY LIVE STEAMERS
Annual Spring Meet
3½" – 4¾" – 7¼"
Ralph Green, Secretary
845 Kilsyth Road
Elizabeth, New Jersey 07208

SEPTEMBER

2 3 4 PENNSYLVANIA LIVE STEAMERS
Annual Fall Meet
2½" – 3½" – 4¾"
Frank H. Moore, Jr., Secretary
211 Walnut Street
Wayne, Pennsylvania 19087

9 10 GOLDEN GATE LIVE STEAMERS
Annual Fall Meet
2½" – 3½" – 4¾" – 7½"
Joseph W. Bryan, Secretary
1225 Scott Street
El Cerrito, California 94530

15 16 17 NEW JERSEY LIVE STEAMERS
Annual Fall Meet
3½" – 4¾" – 7¼"
Ralph Green, Secretary
845 Kilsyth Road
Elizabeth, New Jersey 07208

OCTOBER

12 5th ANNIVERSARY RUN
4¾" gauge
James L. Banning
3333 Kahawalu Drive
Honolulu, Hawaii 96817

REGULAR RUN DAYS

GOLDEN GATE LIVE STEAMERS
Every Sunday, weather permitting
2½" – 3½" – 4¾" – 7½"
Joseph W. Bryan, Secretary
1225 Scott Street
El Cerrito, California 94530

LOS ANGELES LIVE STEAMERS
1st Saturday and Sunday each month
3½" – 4¾" – 7½"
W. Ross Crawford, Secretary
6900 Royer Street
Canoga Park, California 91304

PENNSYLVANIA LIVE STEAMERS
2nd Sunday each month, May thru Oct.
2½" – 3½" – 4¾"
Frank H. Moore, Jr., Secretary
211 Walnut Street
Wayne, Pennsylvania 19087

SOUTHERN CALIFORNIA LIVE STEAM CLUB
3rd Sunday of each month
3½" – 4¾" – 7½"
K. G. Kepner, Secretary
2764 Maple
Rialto, California 92376

WABASH, FRISCO & PACIFIC ASSN.
Every Sunday – 12" gauge
George F. Kiesel, Jr.
6347 N. Rosebury Avenue
St. Louis, Missouri 63105

...from the cupola

An eight-inch high pile of unanswered correspondence and a very late mailing of both the April and May issues of LIVE STEAM indicate that an explanation is in order.

Several weeks ago a rush trip to the doctor's office made "official" a fact that we already knew . . . that while some people can bask in the glow of a candle lighted on both ends, a flame in the middle makes it too hot to handle! Adding LIVE STEAM to our already loaded schedule had, in effect, lighted our candle in the middle. A complete physical checkup (which had long been scheduled for the following week) indicated that there was nothing wrong that an occasional bit of sleep wouldn't cure.

Needless to say it gave us much to discuss here, and a forced slowdown began to show up in all our work. After many long hours of evaluation and discussion with the family we have decided to limit our efforts to two endeavors . . . LIVE STEAM and our work with NEW HOMES GUIDE and HOME MODERNIZING GUIDE Magazines where we have served as Design Consultant for over twelve years. The schedules of these projects are fixed and can be met comfortably without interruption from the other lines of work which we have been doing for many years. The "other lines" included inked illustrations for several technical publications, final inked project maps for a city planning firm as well as an architectural practice. While the work in these fields has been very interesting and rewarding, the schedule is spasmodic and demanding.

It will take us a little while to clear up the backlog of correspondence, but once that is taken care of your letters should get a prompt reply.

And LIVE STEAM will continue . . . on schedule in the future!

—W.C.F. —

The following patterns are available for the use of Live Steamers in construction of their equipment:

3/4" scale, miscellaneous patterns from Carl Purinton

Bettendorf Tender or Riding Car Truck Frame, 4½" wheelbase.

Many additional patterns are available in 1½", ¾" and ½" scales. For a complete list and details about the use of these patterns, send #10 self-addressed stamped envelope to:

LIVE STEAM PATTERN POOL
962 Greenland Road
Portsmouth, N. H. 03801

BUSINESS CARDS

Listings for those firms or individuals in active business.

MINIBOLTS—Perfect little hex head miniature machine bolts in Mild Steel, Brass and Stainless Steel. #0 to #12 diameters, in popular and special lengths. For factory direct" prices write to "BOB" at
SIERRA SWISS PRODUCT ENGINEERING
P. O. BOX 67
FAWNSKIN, CALIF. 92333

RUTLAND F-2J 4–6–0 DRAWINGS
1½" scale elevations and sections
For information write to:
WALTER H. ALLEN
962 GREENLAND ROAD
PORTSMOUTH, N. H., 03801

1½" scale tracks, couplers, stake pockets, frogs, drivers, etc. Send 25¢ for photo and information to
EVERT BRUMLEY
ROUTE #4, BOX 222
WINCHESTER, INDIANA 47394

BALTIMORE & OHIO LOCOMOTIVES
1" scale 4–4–0 and 4–6–0 4½" gauge.
Authentic designs from official company drawings dated 1893. Castings and prints of finest quality. List 25¢
H. J. COVENTRY, P. E.
5300 NORWOOD AVENUE
BALTIMORE, MARYLAND 21207

Phocos, blue line prints of 9 CNR and CPR locos from Montreal and Canadian Locomotive Works tracings. 25¢ for list and specs.
WILLIAM DYKEMAN
890 BAY AVENUE
BATHURST, N. B., CANADA

¾" - 15½" scale
Castings, Blueprints and Materials, 16 engines in Catalog No. 5.
Send $1.00 to
FRIENDS MODELS
R.F.D. TOPSFIELD, MASS. 01983

3/4" SCALE NYC HUDSON
Castings, drawings, freight trucks, wheels, boilerwes, springs. Write for list.
CARL HOFFMAN
25 THORNBRIDGE CRESCENT
KITCHENER, ONTARIO, CANADA

Black line prints from original Cooke, Manchester and Rhode Island Works tracings. Send 50¢ for the lists of drawings.
C. A. PURINTON
R.F.D. BOXFORD, MASS. 01921

LOCOMOTIVES BUILT TO ORDER
Machined to any stage
TORN'S MACHINE & ENGINEERING CO.
808 McPHAUL STREET
AUSTIN, TEXAS 78758

1" scale trucks and car parts
Send for free list
NELSON W. GRAY
900 East Brighton Avenue
Jamesville, N. Y. 13078

THE EXTRA BOARD

Items for sale or wanted to purchase by hobbyists. One free ad included with subscription, additional ads 5¢ per word with order.

WANTED

Partially completed ¾" Live Steam engine either 4–4–0, 4–6–0 or 2–6–0. Engine can be free-lance, Friends or Little Engines. All letters answered. C. H. Merser, Jr., 10 Crommessett Road, Wareham, Mass. 02571.

Electric trains made before 1941. Will pay top cash. Also want Buddy-L push toys. Al Stauter, Route 4, Medina, Ohio 44256.

LOCOMOTIVE CYCLOPEDIA, condition not important. Will pay reasonable price. William C. Fitt, Box 328, Birmingham, Michigan 48012.

FOR SALE

1½" scale 7½" gage 4–6–4 oil burner, 12½ steel boiler, steam operated water pump and 6V generator, excellent steamer. Mrs. Raymond Teerling, 15856 Via Cordoba, San Lorenzo, Calif. 94580, phone 415-276-7704.

1" scale 4–8–4 Northern (used), 8" dia. steel boiler, coal fired, droppable grates, injector, hand pump, excellent steamer, 12-wheel tender, loco and tender approximately 9 feet long. Will accept best offer over $1,475.00 or will take incomplete 1" or 1½" scale loco or parts in trade as part cash. Call or write Elmer Roth, 5 Councilman Ave., Baltimore, Md., 21206, phone 301-668-0485.

Yankee Shop ¾" scale 4–4–2. Cylinders, valve gear, pistons, frame and drive wheels completed, all other castings and blue prints as well as material for copper boiler. Mrs. C. S. Thompson, 3960 South Sherman, Englewood, Colo. 80110.

When writing to advertisers please mention that you saw their ad in LIVE STEAM.

MEMO TO:
MOM AND THE KIDS

FATHER'S DAY
JUNE 18th, 1967

Is a fine time to get the book that Dad's wanted for his Live Steam Library. If you're not sure of the title, order a gift certificate and let him choose his own.

AMERICAN LOCOMOTIVE ENGINEERING — Over 66 new printing of an 1871 book of engravings by the Engineering office of G. Weissenborn. 96 beautifully detailed drawings of 9 locos popular at that time.
PLASTIC COVER $6.00
HARD COVER $9.50

APEX OF THE ATLANTICS, the PRR E-6 Class 4-4-2 locomotives. The research, development and operation covered in 168 pages with 116 photos and 20 drawings. $6.95

ATLANTIC COAST LINE covers the history, steam locos and ships of the Plant System, ABAC, C&WC, P&O SS Co. The 230 pages include nearly 400 photos, maps, charts and diagrams. $12.50

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B&O POWER covers steam, electric and diesel power on the Baltimore & Ohio from 1829 through 1964. Over 800 photos and an all-time roster form a valuable source of information in 352 8½ x 11 pages. $15.00

THE TRAINS WE RODE fill two volumes of about 500 pages each with photos and commentary by Lucius Beebe and Charles Clegg. 801 illustrations in Volume 1 and 1,000 in Volume 2 form a comprehensive photo history of railroading in the U.S.A.
VOLUME I $15.00
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CANADIAN STEAM! A pictorial summary of steam in Canada in its finest and final hour. Moguls and Mountains, Hudsons and Selkirks in photos by the best railroad photographers and edited by David Morgan, Editor of TRAINS Magazine. $6.95

C&NWRY. STEAM POWER by Charles T. Knudsen who served 36 years on the C&NW. Photos, diagrams and history from 1848-1956 plus a 10 x 48" fold-out photo of the Class H 4-8-4 make this a 240-page reference of all phases of steam. $10.00

BUILDER'S CATALOGS of Alco Pacifics, Alco gasoline/diesel compounds, Baldwin Mallet and presentation/ catalog of the early 1900's reprinted 6 x 9" with heavy card covers.
EACH $3.00
SET OF 4 $10.00

CIVIL WAR RAILROADS goes beyond the glorious and panic of the conflict to bring out photos and stories of the wood-burning engines, the rolling stock and stations, the bridges, wrecks and wild rides. $12.50

C&O POWER by Alvin Staufer is a 350-page volume covering steam and diesel power on the Chesapeake & Ohio from 1900 to 1965 with 700 photos and roster. 8½ x 11" pages with hard cover. $15.00

THE 20TH CENTURY is one of the fine works of Lucius Beebe and records sixty years of operations of this world-famous deluxe train. 180 8½ x 11 pages with 200 illustrations. $5.95

THE CENTRAL PACIFIC AND THE SOUTHERN PACIFIC RAILROADS is the biggest and best of the writings of Lucius Beebe. This Centenial Story of a great transcontinental railroad is 640 pages with 900 illustrations. $15.00

THEY FELLED THE REDWOODS tells the story of the destructive redwood lumbering in California. More a documentary of lumbering, its 200 photos include many of Shays previously unpublished. $6.95

IRON HORSES OF THE SANTA FE TRAIL shows on its 612 pages, 1700 illustrations and photos covering 5000 locos from 1869 to present. Printed on heavy 11¼ x 8¼ pages with gold stamped cover. $20.00

THE LOCOMOTIVES THAT BALDWIN BUILT contains a reprint of the "History of the Baldwin Locomotive Works – 1831 to 1923" which author Fred Westing brings up to date with 300 photos. $12.95

LOCOMOTIVE DRAWINGS BY STAUFFER

NYC Hudson, NYC 999, PRR M-1a, SP Daylight, NYC Electric, C&O Mikado, NYC Niagara, P&LE 2-8-4*, Southern P-34, UP Challenger, D&RGW 4-6-6, SP Cab-forward.
34" x 14" (*25" x 10")
EACH $1.50

A LOCOMOTIVE ENGINEER'S ALBUM links the Iron Horse with the history and development of North America. 192 pages with nearly 300 rare photos show engines in mountains and flat lands coast to coast. $12.95

LITTLE RAILWAYS OF THE WORLD covers miniature public railways from all over the world. 272 pages, 246 illustrations $6.00

THE LAST OF STEAM by Joe G. Collias shows steam at its powerful best. A superb pageant of steaming locomotives in the final years of steam is shown in 375 photos in this 272-page book. $10.00

THE MAINE TWO-FOOTERS by Linwood W. Moody is the story of the 24" gauge rail empires that worked against the problems of fires, blizzards and peg-boat traffic. 213 photos and illustrations on the masters in 350 6 x 9 pages. $6.00

MIXED TRAIN DAILY ...the greatest book of mixed trains and short lines ever written. In 370 pages, Lucius Beebe has 300 illustrations. $6.50

MOTIVE POWER OF THE UNION PACIFIC. This 4th Edition contains 336 pages of information about the steam locomotives of the Union Pacific as well as complete plan package in HO gauge scale and full UP roster.
$17.50

NARROW GAUGE IN THE ROCKIES tells the complete story of slim-gauge operators in Utah, Colorado and New Mexico in 290 pictures and press releases. Drawings and paintings by Howard Fogg. 224 pages $8.50

NYC STEAM POWER shows a good cross-section of steam locos that traveled the New York Central System from 1915 to 1957 in 302 action and still pictures. Drawings and paintings with a 1944 roster fill the 224 pages.
$12.00

THE NICKEL PLATE STORY covers also the Clover-Leaf, Lake Erie & Western and the Wheeling & Lake Erie stories and includes 76 pages of illustrated locomotive roster with 6 NKP locs plus elevation drawings. 480 pages, 527 halftones. $16.50

NEVADA COUNTY NARROW GAUGE by G.M. Best relates the tale of the California railroad that hauled gold through the mountains and forests. 224 pages with 284 illustrations.
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O. & W. tells the colorful history all through the long life and slow death of the New York, Ontario & Western Railroad. 212 pages 8 x 10 with 150 illustrations. $5.00

PINO GRANDE is the story of the lagging railroads of the Michigan-California Lumber Co., and the fascination of steam trains in wooded mountains. 175 pages, 200 illustrations. $7.50

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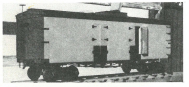

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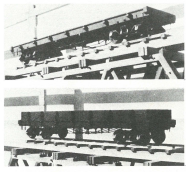

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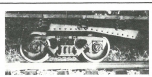

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